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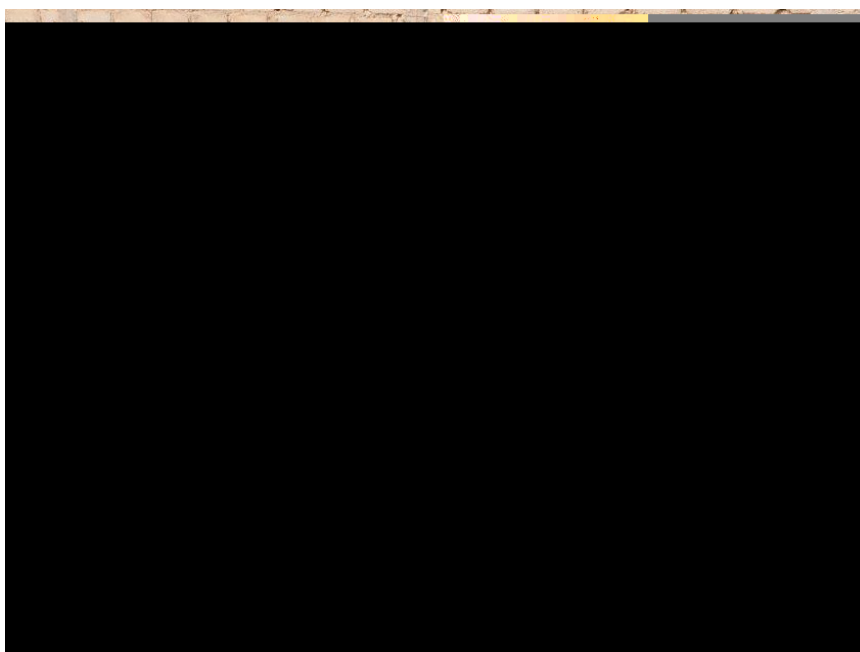
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# Improving dairy cattle productivity in Senegal

Karen Marshall, Stanly Tebug, Gareth R Salmon, Miiika Tapio, Jarmo Juga and Ayao Missohou

The government of Senegal has initiated a National Program for Livestock Development (PNDE) seeking to achieve self-sufficiency in the production of animal-source foods and increase the economic vitality of the value chain by 2026. Improving the productivity and competitiveness of the livestock sector is a key component of the plan. This brief seeks to facilitate the implementation of the dairy cattle sector components of the PNDE, particularly in relation to improving productivity. In doing so it sets out the evidence-based rationale for keeping different dairy cattle breeds/ crossbreeds under different management systems, and makes recommendations regarding key investments to improve dairy cattle productivity.

## Research

The researchers performed trade-off analysis on different smallholder dairy cattle production systems in Senegal (intensive systems excluded). The systems were defined by breed or crossbreed of dairy cattle kept, and level of animal management employed. While the research primarily focused on comparing the productivity and profitability of the systems, other elements (such as in relation to food safety) were also considered.

Table 1. Cattle breed types

Breed types	Description
Indigenous Zebu	Zebu Gobra; Zebu Maure
Indigenous Zebu by Guzerat	Indigenous Zebu crossed with Guzerat; typically 25–50% Guzerat
Indigenous Zebu by Bos Taurus	Indigenous Zebu crossed with Bos Taurus; mainly Montbeliarde and Holstein-Friesian; typically 25–50% Bos Taurus
High Bos Taurus	Indigenous Zebu crossed with Bos Taurus, mainly Montbeliarde and Holstein-Friesian; typically 75–100% Bos Taurus

## Key findings

### Milk yields

The animals with a high proportion of exotic dairy cattle blood (such as Montbeliarde and Holstein-Friesian), kept under good levels of animal management—particularly in relation to animal feed/ nutrition—gave the highest milk yields. Milk yields varied considerably depending on breed type and management level. For instance, milk yields per cow for a 365-day lactation period were 300 litres for an indigenous Zebu kept under a poor (traditional) management system, and 2,250 litres per cow for a high Bos Taurus kept under a good management system.

### Cattle-keeping household profits

Dairy cattle keeping household profits were highest for indigenous Zebu by Bos Taurus animals kept under good management conditions. While the keeping of high Bos Taurus animals resulted in higher revenues, the cost of keeping them (particularly feed costs) meant that high Bos Taurus were not the most profitable cattle. Should feed costs decline, this may change. Profits also varied considerably depending on breed type and management level. Assuming a herd size of eight cows and use of artificial insemination to produce the crossbred animals, keeping indigenous Zebu under poor management resulted in an annual profit of about CFA 60,000 (about USD 100) per cow, while the keeping of Indigenous Zebu by Bos Taurus crossbred animals under better management resulted in an annual profit of about CFA 446,000 per cow, see Marshall et al. 2016a,b.

### Cost-benefit ratio for dairy cattle keeping households

The cost-benefit for dairy cattle keeping households was the highest for the indigenous Zebu by Bos Taurus crossbred animals under better management. For instance, at 1:1.66 for a herd size of eight cows, and 1:1.79 for a herd size of 30 cows.

### Breed preferences of livestock keepers

Both male and female dairy cattle keepers indicated a preference for indigenous Zebu by Bos Taurus crossbred dairy cattle. They cited favourable aspects of this cross as being high milk yield, and good weight/body confirmation.

Concerns in relation to this crossbreed were high feed intake and somewhat poor adaptation to local conditions (including in relation to disease resistance).

## Environmental sustainability—greenhouse gas emission intensity

Greenhouse gas emission intensity was the lowest (i.e. most favourable) for the indigenous Zebu by Bos Taurus crossbred dairy cattle, and highest for Bos Taurus dairy cattle kept under good management. This is largely because the latter were the most productive (i.e. had the highest protein yield) and were fed the highest quality (most digestible) feeds.

## Food safety— aflatoxins

Aflatoxin levels in commonly used supplementary feeds for dairy cattle were high, including purchased concentrate, groundnut cake, millet bran, wheat bran and rice bran. Most samples tested well above the recommended World Health Organization limits for animal feed. Animals ingesting aflatoxin-contaminated feed secrete the aflatoxins in their milk, resulting in a safety risk to humans consuming the milk. As cattle with the higher proportion of exotic dairy cattle blood (such as Montbeliarde and Holstein-Friesian) had the highest level of supplementary feeding, their milk could be expected to present the highest aflatoxin safety risk.

## Gender-related obstacles to increasing the level of market orientation of household dairy enterprises

As household dairy enterprises became more market orientated (produced and sold more milk), there was a tendency for men to control income from the sale of milk. While this is being investigated further, it suggests that increased market orientation may lead to negative impacts on some household members, including children (Doss 2013; Meinzen-Dick et al. 2011). This is particularly relevant for households keeping indigenous Zebu by Bos Taurus, or high Bos Taurus, animals, as they tended to be more market orientated.

## Note on study

This study considered a number of trade-offs associated with different dairy cattle systems. However, due to resource constraints, some were not considered. In particular, the effects of the different systems on other aspects of environmental sustainability requires further investigation.

## Implications

- Indigenous Zebu by Bos Taurus crossbred animals, kept under good management, represent a promising dairy system as long as measures are put in place to ensure a year-round supply of safe animal feed.
- The maintenance of the crossbred animals at around 50% indigenous Zebu and 50% Bos Taurus can be considered a desirable option, as these animals are both adapted to local environmental conditions and productive (the contribution of the indigenous Zebu

and Bos Taurus, respectively). This can be achieved by mating crossbred cows to crossbred bulls. To support such a system, the availability of semen from crossbred bulls for use in artificial insemination is desirable. An alternative would be the use of a rotational crossbreeding scheme. While this scheme does not maintain an exact 50:50 crossbred proportion, it avoids crossing too much in one direction. Here, crossbred cows are alternatively mated with indigenous Zebu and Bos Taurus bulls.

- Cattle keepers investing in indigenous Zebu by Bos Taurus animals need to combine improved genetics with improved animal management (feed, healthcare, and welfare—including housing) to optimally benefit from the improved genetics.
- Households whose dairy enterprises are becoming more market orientated may require capacity building support on equality issues to ensure that no household members are disadvantaged.

Table 2. Summary of examined trade-offs for different dairy cattle-production systems in the study sites in Senegal, as defined by breed-type kept and level of management. Cells highlighted in grey are favourable.

Breed type	Zebu	Zebu	Zebu x Guzerat	Zebu x Guzerat	Zebu x Bos Taurus	Zebu x Bos Taurus	High Bos Taurus
Management level <sup>1</sup>	*	**	*	**	**	***	****
Milk yields (litres milk offtake per 365 day lactation)	307	899	408	907	931	1,863	2,251
Profit of the household dairy enterprise (CFA/cow/annum) <sup>2</sup>	60,000	142,000	65,000	187,000	206,000	446,000	374,000
Cost-benefit ratio of the household dairy enterprise <sup>2</sup>	1:1.22	1:1.32	1:1.23	1:1.44	1:1.47	1:1.66	1:1.41
Breed preference—male/ female dairy cattle keepers <sup>3</sup>	+/+	+/+	+/+	+/+	+++ / +++	+++ / +++	++ / +
Environmental sustainability—greenhouse gas emission intensity (kg CO <sub>2</sub> equivalent/kg protein)	338	190	307	165	188	110	108
Food safety—level of supplementary feeding with aflatoxin contaminated feed	Low	Medium	Low	Medium	Medium	High	Very high
Women control the income from the sale of milk in the majority of households	Yes	Yes	Yes	Yes	No	No	No

<sup>1</sup>The higher the number of asterick (\*) the better the level of animal management; reflective of the investment in animal feed

<sup>2</sup>Assumes a herd size of eight cows (and followers); no transhumance; natural mating for Zebu and Zebu by Guzerat and artificial insemination for Zebu x Bos Taurus and high Bos Taurus

<sup>3</sup>The higher the number of plus signs (+) the stronger the preference for that breed.

## Investment recommendations to improve dairy cattle productivity

1. Establishment of a national dairy cattle breeding scheme aimed at providing genetically superior crossbred bulls and cows, including the:
  - Development of a national performance recording and DNA sampling scheme;
  - Use of performance records and DNA information to provide farmers with feedback on their animals for improved animal management, and identify genetically superior crossbred bulls and cows for use as breeding animals, either by artificial insemination or natural mating;
  - Guarantee of equitable access by cattle keepers to improved dairy cattle genetics by strengthening delivery systems for artificial insemination, including the provision of crossbred semen; and
  - Development of innovative partnership arrangements, including public-private partnerships, to support breeding programs and linked delivery systems for improved dairy cattle genetics in the long-term.
2. Removal of a key constraint to dairy productivity posed by insufficient, poor quality and/or unsafe dairy cattle feed. This can be achieved by: testing and scaling methods for improved fodder production and storage; guaranteeing minimal aflatoxin contamination of cattle

feed; and optimizing dairy cattle diets by combining fodder with other locally available feeds.

3. Building of the capacity of men and women dairy cattle farmers to maximize dairy cattle productivity and, thus, household benefits from dairy cattle through the provision of training on: dairy cattle management—particularly in relation to improved feeding, watering, healthcare and housing practices required when keeping crossbred dairy cattle; marketing practices; and any gender equality issues arising as household dairy enterprises become more market orientated.

**Note:** The above investment recommendations specifically target dairy cattle productivity. It is recognized that investment in other sector components will also be critical to a vibrant dairy sector.

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